

APOGON MOSAVI, A NEW WESTERN ATLANTIC CARDINALFISH,
AND A NOTE ON THE OCCURRENCE OF APOGON LEPTOCALUS
IN THE BAHAMAS

George Dale

The fishes of the Bahamas are perhaps better known than those of any other tropical marine area of comparable size. Thirteen previously described species of the genus *Apogon* have been recorded in the Bahamas (Böhlke and Chaplin, 1968, with the generic reassignments prescribed in Fraser and Robins, 1970), making it the most speciose genus in the ichthyofauna of that area. Most, perhaps all, of the species occur throughout the Bahamas (and probably throughout much of the tropical western Atlantic) and thus may be considered broadly sympatric.

These considerations have made the genus *Apogon* an ideal group in which to investigate the ecological principle of competitive exclusion. This paper is an outgrowth of that investigation. A new species of *Apogon* is described from the Bahamas, Haiti, and Jamaica, and *Apogon leptocaulus* Gilbert is recorded for the first time in the Bahamas.

While teaching a marine biology course given in Nassau, Bahamas, in June, 1975, I spent some time observing the sea anemone association of *Apogon quadrisquamatus* reported by Colin and Heiser (1973), and made some collections. I became aware of certain differences between that species and some of the specimens identified as such that I had examined in the fish collections of the American Museum of Natural History, specifically a large sample from Cat Island, Bahamas, collected in 1968 by C. Lavett Smith and James C. Tyler. Scrutiny of that sample revealed that it was indeed distinct from, though closely related to, *A. quadrisquamatus*. An additional specimen from the Bahamas, collected by C. L. Smith in 1966, two large samples, one from the Bahamas and one from Haiti, in the fish collections of the Academy of Natural Sciences of Philadelphia (ANSP), and a small Jamaican sample from the University of Miami Marine Laboratory (UMML) provided the study material.

Meristic data in the description are based on 20 specimens, except lower limb gill raker counts (224 specimens) and preopercular margin serrae counts (42 specimens). Morphometric data are based on 12 specimens, except that the upper jaw length, ventral fin length, and caudal peduncle length, are based on measurements of 42 specimens.

The holotype is deposited at the American Museum of Natural History (AMNH). Paratypes are deposited at AMNH, ANSP, UMML, and the National Museum of Natural History (USNM). Comparative material (*A. quadrisquamatus*) was obtained from AMNH, ANSP, and USNM. Mea-

surements and counts were made according to Hubbs and Lagler (1958) and are presented in a format similar to that of Böhlke and Chaplin (1968).

Apogon mosavi, new species

Dwarf cardinalfish

Fig. 1

Holotype.—AMNH 35782 (29.7 mm SL), Bahamas, Cat Island, Hawksnest Creek, ½ mi from shore, patch reef at dropoff, depth 85 to 105 ft, 31 January 1968, C. L. Smith and J. C. Tyler.

Paratypes (collected with the holotype).—AMNH 34481 (111 specimens, 18.6–34.0 mm SL); ANSP 137482 (5, 26.7–28.1); UMML 32962 (5, 28.3–29.5); USNM 216595 (5, 27.9–29.0).

Other material examined.—AMNH 29896 (1, 33.6 mm SL), Bahamas, Great Abaco, Southwest Point, 300 ft from shore, patch reef, depth 40 ft, 9 December 1966, C. L. Smith and B. Hanna; ANSP 124036 (117, 17.7–27.9), Bahamas, Grand Bahama, ca. 2 mi SW of Deep Water Bay, depth 90–95 ft, 6 December 1969, W. A. Starck, J. D. Starck, and P. Hopper; ANSP 113434 (558, 14.6–28.4), Haiti, Gulf of Gonave, St. Marc Channel, off Mt. Rouis, depth 120–135 ft, 16 September 1967, J. C. Tyler, H. A. Feddern, T. Devany, and J. Durocher; UMML 31181 (13, 26.4–30.9), Jamaica, Discovery Bay, Buoy Reef, depth 120 ft, 29 June 1972, P. Colin.

Comparative material (Apogon quadrisquamatus).—Bahamas: AMNH 27123, 28737, 28756, 28825, 29891, 30513, 30523, 33109, 33144, 33807, 34340; AMNH uncat.: field no. GD73-11, GD75-1, GD75-3, GD75-4, GD75-5, GD75-7; ANSP 97014, 97017, 97019, 97022, 97023, 97026, 97027, 97029. Florida: USNM 107325 (lectotype), 108888 (paratypes), 213474, 213475. Puerto Rico: USNM 207020, 207021, 213603, 213604, 213605. Grand Cayman: ANSP 102440. Lesser Antilles: ANSP 106536, 106537, 106545. Nicaragua: USNM 179231, 213601. Colombia: ANSP 112685; USNM 213606, 213607, 213608, Acc. 254315. Surinam: USNM 186430. Brazil: USNM 213602.

Diagnosis.—A species of the genus *Apogon*, subgenus *Apogon* (see "Remarks" below), with 8 segmented anal rays (last ray composite); 2–5 median predorsal scales; 13–16 gill rakers on lower limb of first gill arch (rarely 13 or 16, modally 15); 16 circumpeduncular scales; rear margin of fleshy posteroventral portion of free preopercular margin anterior to a ventral continuation of the line formed by the vertical edge of the preopercular margin; coloration (in alcohol) pale; scattered, slightly enlarged melanophores on cheek and behind eye, giving these areas a freckled appearance; a basicaudal bar; no markings on fins.

Description.—Dorsal rays VI-I, 9 (last ray composite); anal rays II, 8 (last ray composite); pectoral rays 12; lateral-line scales to caudal-fin



Fig. 1. *Apogon mosavi*, holotype, AMNH 35782, 29.7 mm SL, off Cat Island, Bahamas.

base 24; scales above lateral line 2; scales below lateral line 6 or 7; median predorsal scales 2-5; scales around caudal peduncle 16; gill rakers on first gill arch 4-6 (mostly 5) + 13-16 (mostly 15, rarely 13 or 16); serrae along vertical limb of free preopercular margin 8-20, on 42 specimens 19.4-34.0 mm SL.

Greatest depth of body contained 2.7-3 times in SL; length of caudal peduncle 1.1-1.3 times in greatest body depth, 3.4-3.7 times in SL; least depth of caudal peduncle 1.7-2.1 times in its length; head length 2.2-2.3 times in SL; eye diameter 2.7-3.1 times in head length; snout short, its length about 5 times in head length; end of snout bluntly rounded; dorsal profile of head convex from snout to origin of dorsal fin.

First dorsal spine 1.8-2.1 times in length of second spine; second dorsal spine slightly longer than third; second dorsal spine thickest spine in fin; spine of second dorsal fin 1.1-1.3 times in second spine of first dorsal fin; ventral fins short, extending to anus or slightly behind; innermost ventral ray connected to body by membrane at a point $\frac{2}{5}$ - $\frac{3}{5}$ of the way out on its mesial branch; pectoral fins narrow and rather long, extending to above point along anterior third of anal-fin base; first anal spine short, its length 4-5 times in length of second spine; second anal spine about equal in length to spine of second dorsal fin; caudal fin forked, the lobes rounded.

Upper angle of rear margin of maxillary at or slightly behind a vertical at rear margin of pupil; rear margin of maxillary slightly concave; upper edge of maxillary slipping up beneath suborbital when mouth is closed; no orbital or anterior orbital serrations; posterior margin of preopercle serrate, the number of serrations tending to increase with the size of the specimen; a rounded flap of skin at angle of preopercle, not extending beyond an imaginary ventral continuation of the line formed by the free posterior margin of the preopercle; free tip of opercular spine short, narrow, and sharp; posterior nostril a vertically elongate opening nearer to eye than to anterior nostril.

Large ctenoid scales present on cheek and opercle; scales on body all finely ctenoid, including those on thorax and nape, except for a few anteriorly on thorax and those before pectoral fin base; scales on nape extending forward to occiput; fins naked except for small scales basally on caudal fin; lateral line complete; lateral-line scales similar in size to adjacent body scales.

Tiny villiform teeth in bands on jaws, a few near front of upper jaw and laterally on lower jaw very slightly enlarged; vomer and palatine with irregularly uniserial villiform teeth; palatine sometimes lacking teeth; gill rakers on first arch long, longest gill filament in outer series contained 3-4 times in longest raker; tip of lower jaw extends more anteriorly than upper jaw.

Caudal skeleton with three separate elements in hypural fan (hypurals

1 and 2 fused, 3 and 4 fused, 5 separate) in 211 of 225 specimens X-rayed, four elements (hypurals 1 and 2 fused, 3, 4, and 5 separate) in 14 specimens; 10 precaudal + 14 caudal vertebrae; 2 predorsal bones located anterodorsal to neural spines of first and second vertebrae, respectively.

Color in life unknown; color in alcohol pale with slightly enlarged melanophores scattered on cheek and behind eye, giving these areas a freckled appearance; a dense pattern of small melanophores on nape make this region dusky; upper half of body has peppering of tiny melanophores, which tend to be concentrated on the edges of the scales; lower half of body with little or no pigmentation; dark brown bar at base of caudal fin about as wide as pupil; this bar usually slightly wider dorsally; the posterior margin of this bar just anterior to the posterior margin of the hypural fan; all fins colorless; a silvery iris, a silvery iridescence shining through integument of cheek and opercular region, and a silvery peritoneum shining through body wall are conspicuous on the holotype and the other specimens in the type collection, but rare or absent (probably an artifact of preservation) in the other collections; peritoneum often marked with scattered, enlarged melanophores.

Morphometric data for the holotype and 11 other specimens (4 paratypes from AMNH 34481, 2 specimens each from ANSP 124036, ANSP 113434, and UMML 31181, and the single specimen AMNH 29896) are given in the following paragraph. The measurements given for each character designate, in order, the holotype, the mean of all 12 specimens, and the range of all 12 specimens. All measurements are given in thousandths of SL. Greatest body depth 360, 348.8, 329–365; greatest body width 182, 178.8, 146–196; snout to first dorsal fin 458, 443.3, 424–460; snout to second dorsal fin 620, 622.7, 610–638; snout to anal fin 646, 645.3, 606–671; snout to pectoral fin 414, 424.1, 405–453; snout to ventral fin 407, 413.8, 393–464; snout to anus 630, 615.5, 587–636; least depth of caudal peduncle 162, 150.5, 135–162; caudal peduncle length 273, 278.2, 266–291; head length 451, 438.3, 428–451; head depth at occiput; 303, 301.3, 264–325; eye diameter 158, 149.8, 142–162; snout length 88, 88.3, 83–95; upper jaw length 222, 222.8, 214–235; bony interorbital width 91, 94.2, 85–103; first spine of first dorsal fin 91, 86.0, 71–92; second spine of first dorsal fin 182, 169.5, 155–186; spine of second dorsal fin 155, 149.2, 136–163; longest dorsal soft ray 256, 246.3, 234–262; first anal spine 37, 32.7, 27–37; second anal spine 148, 143.1, 132–160; longest anal soft ray 210, 205.4, 187–227; longest pectoral ray 249, 244.3, 232–258; ventral spine 155, 150.6, 135–179; ventral fin length 215, 207.3, 198–219; caudal fin length 306, 318.8, 306–338; shortest caudal ray 239, 232.4, 219–240.

Remarks.—Assignment of this species to *Apogon* is based on its close similarity to *Apogon quadrisquamatus* Longley. However, in contrast to other *Apogon* species, having five free hypurals, the new species (and

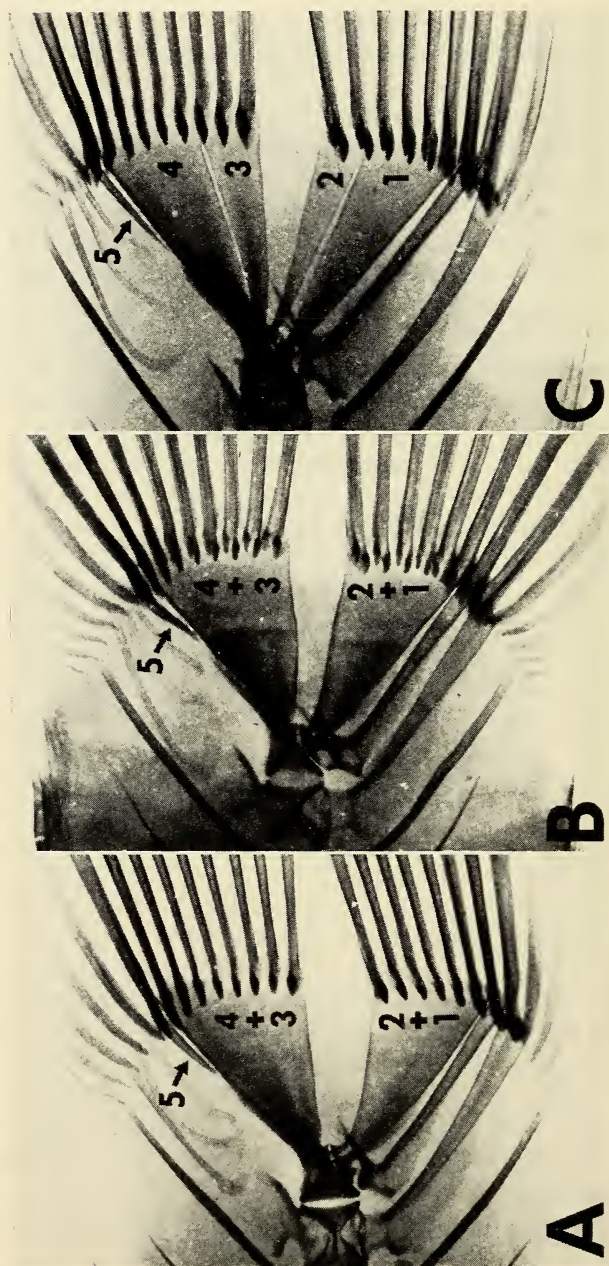


Fig. 2. Typical caudal skeletons of three *Apogon* species. A and B show fusions of hypurals 1 and 2, 3 and 4; C shows five free hypurals. A. *Apogon mosati* (AMNH 34481, 30.7 mm SL). B. *A. quadrisquamatus* (AMNH uncat., field no. GD75-1, 30.1 mm SL). C. *A. maculatus* (AMNH uncat., field no. GD73-2, 34.9 mm SL). Positives prepared from X-ray negatives.

Table 1. Fusions of hypural bones in caudal skeleton of 225 specimens of *Apogon mosavi* (from 4 collections) and 104 specimens of *A. quadrisquamatus* (from 19 collections), as determined from X-rays.

	<i>A. mosavi</i>	<i>A. quadrisquamatus</i>
3 hypurals (1 and 2 fused, 3 and 4 fused, 5)	211	71
4 hypurals (1 and 2 fused, 3, 4, and 5 separate)	14*	3†
4 hypurals (3 and 4 fused, 1, 2, and 5 separate)	—	16†
5 hypurals (no fusions)	—	14†

* The separation of hypurals 3 and 4 in these 14 *A. mosavi* specimens is a minute but distinct separation of the posterior $\frac{3}{4}$ of the length of these bones. Anteriorly, a faint line indicates a continuation of the separation, but this is questionable.

† "Non-fusions" in *A. quadrisquamatus* are typically rather wide separations, similar to those of other *Apogon* species.

also *A. quadrisquamatus*) usually has three hypural elements (Table 1, Fig. 2). Nevertheless, all other characters studied place it in *Apogon*, and Fraser's (1972) keys to apogonid subfamilies, genera, and subgenera place it (and *A. quadrisquamatus*) in *Apogon* (*Apogon*). The diagnosis given above for *A. mosavi* distinguishes it from all other species assigned by Fraser to this subgenus, and in the western Atlantic from all other shallow water cardinalfishes (including *Apogon* (*Apogon*) species, *Apogon* of other subgenera, *Phaeoptyx*, and *Astrapogon*).

The characters in the diagnosis which distinguish *Apogon mosavi* from *A. quadrisquamatus*, with which it would most likely be confused, are those involving pigmentation and gill raker counts. These, as well as certain morphometric characters separating the species, are detailed below.

In alcohol there are no dark markings on the head (ignoring the rather inconspicuous dusky region on the nape) except scattered melanophores, larger than those on the body, distributed in the region immediately below and behind the eye. In *A. quadrisquamatus* the head is peppered all over with small melanophores, similar in size to those on the body, and there is usually discernable a concentration of these into a slender triangular streak extending posteroventrally from the posteroventral border of the eye. The body of *A. mosavi* is pale, with pigmentation in the form of scattered, tiny melanophores usually limited to the dorsal half of the body. Body pigmentation of *A. quadrisquamatus* is variable, sometimes dark, and occurs both dorsally and ventrally. *A. mosavi* lacks pigmentation on the fins, except for a few rare instances of a hint of pigmentation on the first dorsal fin, in contrast to *A. quadrisquamatus*, which nearly always has some pigmentation on the first dorsal fin. In some dark specimens this takes the form of an irregular streak across the second and third spines. Such specimens also tend to have a dusky stripe at both the second dorsal-fin base and the anal-fin base. *A. mosavi* has a basicaudal bar, nearly

Table 2. Gill raker counts on lower limb of first gill arch, done on right side of 224 specimens of *Apogon mosavi* and 63 specimens of *A. quadrisquamatus*. Counts include raker at angle and all rudiments.

	Number of Lower Limb Gill Rakers				
	12	13	14	15	16
<i>A. mosavi</i>	—	2	101	117	4
<i>A. quadrisquamatus</i>	8	48	7	—	—

always quite distinct, while *A. quadrisquamatus* typically has a smudgy spot in that region. In pale specimens of the latter species this spot is faint or lacking. In a few very dark specimens the spot is prominent and vertically elongate, approaching a bar-like appearance, but these specimens typically have distinct fin pigmentation, a distinct triangular streak at the eye, and dense pigmentation dorsally and ventrally on the body, characters always absent in *A. mosavi*.

Differences in gill raker count between *A. mosavi* and *A. quadrisquamatus* are shown in Table 2.

Morphometric characters helpful in distinguishing *A. mosavi* from *A. quadrisquamatus* are slight differences in upper jaw length, ventral fin length, and caudal peduncle length (Table 3). Since the latter two characters, in which the interspecific difference is greatest, vary inversely in the two species, combining them as "caudal peduncle length/ventral fin length" provides a character ratio which maximizes the separation of the two species (Table 3, Fig. 3).

Ecology.—The type collection was part of a large, diverse rotenone sample made at 85–105 ft, from a patch reef at the dropoff edge, about ½ mi off Cat Island, Bahamas. This sample included five other apogonid species (*Apogon affinis*, *A. lachneri*, *A. phenax*, *A. townsendi*, and *Phaeop-*

Table 3. Comparison of certain morphometric characters in *Apogon mosavi* and *A. quadrisquamatus*. Values for mean, range, and standard deviation (SD) of upper jaw, ventral fin, and caudal peduncle lengths are in thousandths of standard length. Caudal peduncle length/ventral fin length (C.P.L./V.F.L.) is a simple ratio.

	<i>A. mosavi</i> (19.4–34.0 mm SL)				<i>A. quadrisquamatus</i> (19.4–57.9 mm SL)			
	N	Mean	Range	SD	N	Mean	Range	SD
Upper jaw length	42	222.4	211–242	6.4	46	236.0	221–248	5.6
Ventral fin length	42	208.3	170–226	10.1	56	240.2	216–269	10.2
Caudal peduncle length	42	277.5	259–293	8.8	57	257.4	217–283	12.8
C.P.L./V.F.L.	42	1.34	1.17–1.69	0.08	56	1.07	0.92–1.26	0.07

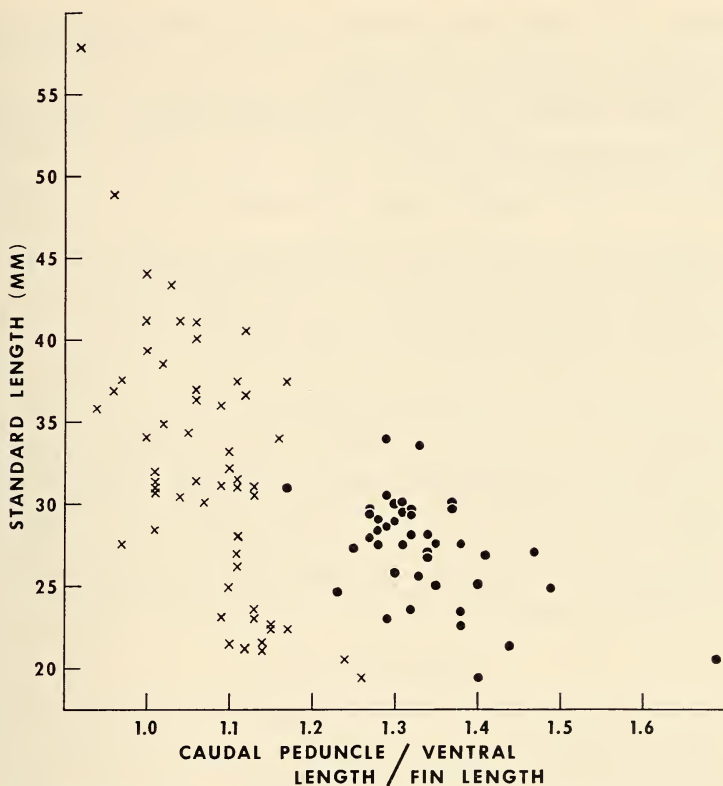


Fig. 3. Relationship of standard length to the ratio of caudal peduncle length to ventral fin length, in *Apogon mosavi* (●) and *A. quadrisquamatus* (×).

tyx conklini) and 36 species of other fish families. The other four known collections of *A. mosavi* were also part of samples from coral reef habitats taken at depths of 40–135 ft. The sample including the single specimen of *A. mosavi* (AMNH 29896) also included four specimens of the closely related species *A. quadrisquamatus*.

The fact that the largest individual in the five collections (816 specimens) of *A. mosavi* is 34.0 mm SL (one of the paratypes) indicates that this is a diminutive species (the upper size range of all other western Atlantic *Apogon* species, some known from far fewer specimens, substantially exceeds 34.0 mm SL). This is supported by the finding of 11 specimens (23.4–28.5 mm SL) from two collections (ANSP 113434 and ANSP 124036) which are ripe females, and 13 specimens (21.8–27.7 mm SL) from the same two collections with eggs or embryos in the mouth. Most or all of these specimens evidently represent oral brooding individuals. Details of these findings will be published elsewhere.

Etymology.—The trivial name *mosavi*, an acronym for Mount Saint Vincent, recognizes the College of Mt. St. Vincent's annual summer course in marine biology, conducted in the Bahamas.

The suggested common name, dwarf cardinalfish, refers to the small size of this species, as detailed above.

Apogon leptocaulus Gilbert

The description of *Apogon leptocaulus* Gilbert (1972) was based on single specimens from three localities, one off Florida and two in the western Caribbean (British Honduras and Providencia Island, Colombia). Identification of a single specimen (AMNH 33179, 27.7 mm SL), collected by C. L. Smith and J. C. Tyler on 22 January 1968 off Southeast Point at Mayaguana Island, as *A. leptocaulus* extends the known range of this species to the Bahamas. It was part of a rotenone collection from a patch reef at 70–80 ft. This specimen essentially agrees in descriptive details, meristics, and morphometrics with the type specimens.

In addition, I have been informed (P. Colin, pers. comm.) that a published photograph of *A. leptocaulus* (Colin, 1974) was taken in the Bahamas, on the Exuma sound side of Eleuthera at about 80 ft depth.

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Department of Ichthyology, American Museum of Natural History, New York, New York 10024.

Present address.—Department of Biological Sciences, Fordham University, Bronx, New York 10458.